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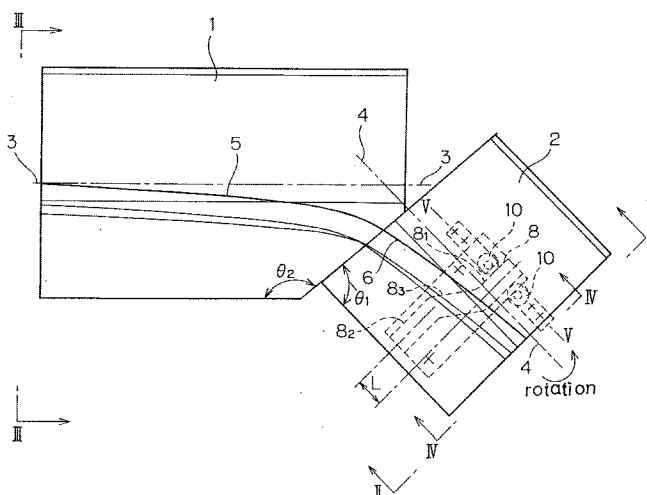
(54) **Negative angle forming type rotary cam moving apparatus**

(57) The present invention provides a rotary cam moving apparatus of a negative angle shaping mold which can avoid an interference of rotary cams, require no canceling process in rotary cam end portions with a high accuracy, and maintain a strength in the rotary cam end portion.

There is provided a rotary cam moving apparatus of a negative angle shaping mold comprising: a lower mold which mounts a metal thin plate work on a supporting portion; an upper mold which descends in a linear direction with respect to the lower mold and comes into contact with the work to shape the work; a rotary cam which forms an intrusion shaping portion intruded from a locus of the upper mold in an edge portion close to the supporting portion, and is rotatably provided in the lower mold; a slide cam which has an intrusion shaping

portion, and is slidably provided so as to oppose to the rotary cam; and an automatic resetting device which rotates and moves backward the rotary cam to a backward moved state capable of taking out the work from the lower mold after shaping, and is provided in the lower mold, in which the work mounted on the supporting portion of the lower mold is shaped by the intrusion shaping portion of the rotary cam and the intrusion shaping portion of the slide cam by sliding the slide cam, and the shaped work is taken out from the lower mold by rotating and moving backward the rotary cam by means of the automatic resetting device after shaping, and a plurality of rotary cams are continuously arranged in an oblique shape, wherein one rotary cam (1) of the adjacent rotary cams is moved so as to be apart from another rotary cam (2) at a time of being rotated to a backward moved state.

FIG. 1



Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a negative angle forming type rotary cam moving apparatus which forms a thin plate made of metal, and more particularly to a negative angle forming type rotary cam moving apparatus in which a plurality of rotary cams are continuously arranged in an oblique shape. In this case, the negative angle forming type means a formation intruding into an inner portion of a lower mold from a descending locus of an upper mold in a linear direction.

[0002] The negative angle formation in which the metal thin plate work is intruded into the inner portion of the lower mold from the descending locus of the upper mold in the linear direction is normally executed by using a slide cam.

[0003] The conventional formation in which the metal thin plate work intrudes into is executed by mounting the work on the lower mold, descending the upper mold to a vertical lower side so as to drive a passive cam in the lower mold by an activating cam in the upper mold, working the work from a lateral direction and moving the activating cam backward by a spring after the working is completed and the upper mold is ascended.

[0004] In this case, a shaping portion of the activating cam which is slid from a lateral direction in an external portion of the work and shapes the work is formed in an integral shape which is the same as a shape of the shaping portion of the work, however, since it is necessary to take out the work from the lower mold after the process is completed, it is necessary that the shaping portion of the lower mold on which the work is mounted is structured such as to be capable of taking out the work by separating the intruding portion in the lower mold so as to move backward or canceling the rear portion of the intruding portion so as to move the work forward. In the case that a level of intrusion is a little, no great problem is generated, however, in the case that the level of intrusion is large or in the case that the work is a part having a narrow frame shape and a groove-shaped cross section, for example, a front pillar outer made of the metal thin plate in a motor vehicle, not only it is impossible to clearly form the shape by the shaping portion of the passive cam, but also a strength of the lower mold comes short, if the intruded lower mold portion is separated or canceled due to a narrow groove width of the work. Accordingly, it is impossible to execute the intrusion shaping process.

[0005] Further, there is a case that a torsion or a strain is generated in a product and it is necessary to fix the product, however, the parts constituting an outer panel portion of the motor vehicle such as a side panel, a fender, a roof, a hood, a trunk lid, a door panel and a front pillar outer have three-dimensional curved surface and

curved lines, so that it is hardly possible to fix the product in fact. In the case of assembling the metal thin plates of the motor vehicle, if the torsion or the strain is generated in the products, it is hard to connect to the other parts, it is impossible to provide a metal thin plate structure for the motor vehicle having a high quality, and it is impossible to maintain a predetermined product accuracy in the metal thin plate shaped product.

[0006] In order to solve the problem mentioned above, the following structure is proposed for the purpose of rotating the rotary cam to a shaping attitude by an automatic resetting device, shaping the shaping portion which is intruded within the lower mold from the descending locus of the upper mold in the linear direction and rotating and moving backward the rotary cam to the state in which the shaped work can be taken out from the lower mold by the automatic resetting device after being shaped.

[0007] That is, as shown in Figs. 15 to 20, a negative angle shaping mold is structured by a lower mold 102 which mounts a metal thin plate work W on a supporting portion 101, and an upper mold 103 which descends in a linear direction with respect to the lower mold 102 and comes into contact with the work W so as to shape the work W. The negative angle shaping mold is constituted by a rotary cam 106 which is open to an outer peripheral surface, has a groove 104 formed in a axial direction, forms an intrusion shaping portion 105 intruded from a locus of the upper mold 103 in an edge portion of the groove 104 close to the supporting portion 101, and is rotatably provided in the lower mold 102, a slide cam 108 which has an intrusion shaping portion 107, and is slidably provided in the upper mold 103 so as to oppose to the rotary cam 106, and an air cylinder 109 for an automatic resetting device which rotates and moves backward the rotary cam 106 to a state capable of taking out the work W from the lower mold 102 after shaping, and is provided in the lower mold 102. The work W mounted on the supporting portion 101 of the lower mold 102 is shaped by the intrusion shaping portion 105 of the rotary cam 106 and the intrusion shaping portion 107 of the slide cam 108 by sliding the slide cam 108, and the shaped work W can be taken out from the lower mold 102 by rotating and moving backward the rotary cam 106 by means of the air cylinder 109 after shaping.

[0008] A description will be given of an operation of the negative angle shaping mold.

[0009] At first, as shown in Fig. 15, the upper mold 103 is positioned at a top dead center, and at this time, the work W is mounted on the supporting portion 101 of the lower mold 102. At this time, the rotary cam 106 is in a backward moving attitude by the air cylinder 109.

[0010] Next, as shown in Fig. 16, the rotary cam 106 is in a shaping attitude by the air cylinder 109. The upper mold 103 starts descending, and the pad 110 presses the work W mounted on the supporting portion 101 of the lower mold 102.

[0011] Subsequently, the upper mold 103 is descend-

ed, and as shown in Fig. 17, a lower surface of the slide cam 108 is brought into contact with a rotary plate 111 without the slide cam 108 being interfered with the intrusion shaping portion 105 of the rotary cam 106.

[0012] When the upper mold 103 goes on further descending, the slide cam 108 which is energized in an outer direction of the mold moves to a left side in a lateral direction due to an operation of the cam against an energizing force of a coil spring 112, and becomes in a state shown in Fig. 18, whereby an intrusion shaping of the work W is executed by the intrusion shaping portion 105 of the rotary cam 106 and the intrusion shaping portion 107 of the slide cam 108.

[0013] After the intrusion shaping, the upper mold 103 starts ascending as shown in Fig. 19.

[0014] The slide cam 108 is energized in the outer direction of the mold by the coil spring 112, is moved to a right side in Fig. 20 and is ascended without being interfered with the intrusion shaped work W.

[0015] On the contrary, the slide cam 108 is ascended, and the rotary cam 106 is rotated to a right side in Fig. 16 by the air cylinder 108. Accordingly, at a time of taking out the intrusion shaped work W from the lower mold 102, the work W can be taken out without being interfered with the intrusion shaped portion 105 of the rotary cam 106.

[0016] In this case, in recent days, a high accuracy is going to be required particularly for the metal thin plate structure of the motor vehicle, and a plurality of metal thin plate shaped products tend to be integrally formed. Accordingly, it is impossible to work the negative angle shaping portion in the large-sized work by one rotary cam, and a plurality of rotary cams are continuously arranged so as to execute the shaping process.

[0017] As mentioned above, the rotary cam 106 takes the shaping attitude in accordance with a compressing operation of a piston rod 113 in the air cylinder 109, and takes the backward moving attitude in accordance with an expanding operation of the piston rod 113 in the air cylinder 109.

[0018] In the case that the adjacent rotary cams are arranged in the other oblique shapes than the linear shape, the adjacent rotary cams are interfered with each other at a time when the rotary cams are rotated. In order to avoid this interference, it is necessary to execute the canceling process of canceling the interfered portion at a high accuracy, and a strength in the cancelled portion is lowered

SUMMARY OF THE INVENTION

[0019] Accordingly, the present invention is made by taking the matters mentioned above into consideration, and an object of the present invention is to avoid an interference of rotary cams in a negative angle shaping mold. Further aspects are to avoid a canceling process in the rotary cam end portions, thereby reducing costs due to the high accuracy of the canceling process during

manufacturing of the rotary cams and avoiding a reduction of the strength of the end portions.

[0020] In order to solve this object the present invention provides a negative angle shaping mold comprising a lower mold with a supporting portion on which a metal thin plate work can be mounted; an upper mold which is adapted to descend in a linear direction with respect to said lower mold and to come into contact with the work; a rotary cam comprising a plurality of rotary cam sections rotatably provided in the lower mold and being provided with an intrusion shaping portion intruded from a locus of the upper mold in an edge portion close to the supporting portion; a slide cam slidably provided so as to oppose to said rotary cam and having an intrusion shaping portion for shaping the work in cooperation with the intrusion shaping portion of the rotary cam; an automatic resetting device provided in the lower mold for rotating and moving backward the rotary cam to a backward moved state where the work can be taken out from the lower mold after shaping; and a rotary cam moving means for moving at least one of said rotary cam sections apart from an adjacent one of said rotary cam sections when the rotary cam is rotated to a backward moved state.

[0021] Preferred embodiments of the a negative angle shaping mold are defined in the dependent claims.

[0022] Further, in accordance with the present invention, in particular, there is provided with a rotary cam moving apparatus of a negative angle shaping mold, wherein a moving rail and a roller for guiding the moving rail are provided as moving means for moving the rotary cam from another rotary cam.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a plan view which shows a shaping attitude of rotary cams in accordance with one particular embodiment of the present invention;

Fig. 2 is a view as seen along a line II-II in Fig. 1;

Fig. 3 is a view as seen along a line III-III in Fig. 1;

Fig. 4 is a view as seen along a line IV-IV in Fig. 1;

Fig. 5 is a view as seen along a line V-V in Fig. 1;

Fig. 6 is a plan view of a state in which one rotary cam in the particular embodiment in accordance with the present invention is moved backward and rotated at 30° ;

Fig. 7 is a view as seen along a line VI-VI in Fig. 6;

Fig. 8 is a view as seen along a line VIII-VIII in Fig. 6;

Fig. 9 is a plan view of a state in which one rotary cam in the particular embodiment in accordance with the present invention is moved backward and rotated at 30° , and is moved at a desired distance with respect to another rotary cam;

Fig. 10 is a view as seen along a line X-X in Fig. 9;

Fig. 11 is a view as seen along a line XI-XI in Fig. 9;

Fig. 12 is a plan view of a state in which one rotary

cam in the particular embodiment in accordance with the present invention is moved backward and rotated at 30° , and is moved at a desired distance with respect to another rotary cam, and another rotary cam is backward moved and rotated at 20° ; Fig. 13 is a view as seen along a line XIII-XIII in Fig. 12;

Fig. 14 is a view as seen along a line XIV-XIV in Fig. 12;

Fig. 15 is a vertical cross sectional view of a state in which an upper mold of a negative angle shaping mold executing an intrusion shaping is at a top dead center;

Fig. 16 is a vertical cross sectional view of a state in which the rotary cam becomes in a shaping attitude by an air cylinder, and the upper mold descends so as to press the work by a pad, in the negative angle shaping mold;

Fig. 17 is a vertical cross sectional view of a state in which the upper mold of the negative angle shaping mold descends so as to be brought into contact with a lower mold and start coming into contact with the work;

Fig. 18 is a vertical cross sectional view of a state in which the upper mold of the negative angle forming mold is at a bottom dead center;

Fig. 19 is a vertical cross sectional view of a state in which an intrusion shaping process is completed and the upper mold starts ascending, in the negative angle shaping mold; and

Fig. 20 is a vertical cross sectional view of a state in which the negative angle shaping mold executes the intrusion shaping, and the upper mold further ascends and is at the top dead center.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0024] A description will be in detail given below of a particular embodiment in accordance with the present invention with reference to the accompanying drawings.

[0025] Figs. 1 to 3 show a shaping attitude of rotary cams 1 and 2. Figs. 6 to 8 show a state in which the rotary cam 1 is stopped and the rotary cam 2 is moved backward and rotated at 30° , whereby end portions are interfered with each other. Figs. 9 to 11 show a state in which the rotary cam 2 is moved so as to be apart from the rotary cam 1 (about 10 mm) for the purpose of avoiding the interference between the end portions shown in Figs. 6 to 8. Figs. 12 to 14 show a state in which the rotary cam 1 is further moved backward and rotated at 20° after the rotary cam 2 is moved backward and rotated at 30° .

[0026] Figs. 1 to 3 shows the shaping attitude of the rotary cams 1 and 2.

[0027] Fig. 2 is a view as seen along a line II-II in Fig. 1 and Fig. 3 is a view as seen along a line III-III in Fig. 1. In Figs. 1, 4 and 5, there is provided a moving apparatus which moves the rotary cam 2 in a direction of mov-

ing apart from the rotary cam 1 at a time of moving backward and rotating the rotary cam 2.

[0028] Reference numerals 3-3 and 4-4 respectively denote axes of rotation of the rotary cams 1 and 2, and reference numerals 5 and 6 denote corner ridge lines of the rotary cams 1 and 2 which form base ends of intrusion portions for a work. The corner ridge line 5 and the corner ridge line 6 are smoothly connected in the shaping attitude, and the intrusion portions are respectively formed from the corner ridge lines 5 and 6.

[0029] As an apparatus by which the rotary cam 2 is moved in a direction of moving apart from the rotary cam 1 at a time of being backward moved and rotated, a moving rail 8 is firmly fixed to the rotary cam 2 via a bracket 7, as shown in Figs. 1, 4 and 5. The moving rail 8 extends in a direction orthogonal to the rotational axis 4 of the rotary cam 2, and is shifted in an axial direction as illustrated between a start of the backward movement and rotation and an end of the backward movement and rotation.

[0030] Rollers 10 which are rotatably provided in a lower mold 9 are brought into contact with both sides of the moving rail 8, whereby the moving rail 8 is guided. When backward moving and rotating the rotary cam 2, the moving rail 8 is guided by the roller 10, and the rotary cam 2 is moved at a preset distance L in an axial direction. The moving rail 8 is constituted by a start straight portion 81, an end straight portion 82 and an intermediate oblique portion 83, and when the start straight portion 81 and the end straight portion 82 are positioned between the rollers 10, the rotary cam 2 is not moved in the axial direction.

[0031] In this case, when rotating the rotary cam 2 by the air cylinder, a connection portion between a front end of a piston rod in the air cylinder and the rotary cam 2 is structured such as to allow the rotary cam 2 to move in the axial direction.

[0032] Figs. 6 to 8 show a state in which the rotary cam 1 is stopped and the rotary cam 2 is moved backward and rotated at 30° .

[0033] As shown in Fig. 6, when the rotary cam 1 is stopped and the rotary cam 2 is backward moved and rotated at 30° , the end portion of the rotary cam 1 is interfered with the end portion of the rotary cam 1.

[0034] In Fig. 1, in the case that an end surface angle θ_1 of the rotary cam 2 is 90° , the rotary cam 2 is not interfered with the end surface of the rotary cam 1 even when the rotary cam 2 is backward moved and rotated. However, in the case that the end surface angle θ_1 is an acute angle as illustrated, the end surface is interfered with the end surface of the rotary cam 1. In the case that the end surface angle θ_1 is an obtuse angle, the end surface is not interfered with the end surface of the rotary cam 1.

[0035] Figs. 9 to 11 show a state in which the rotary cam 1 is stopped, the rotary cam 2 is backward moved and rotated at 30° , and at the same time the rotary cam 2 is moved apart from the rotary cam 1 at 10 mm. The

end portion of the rotary cam 2 is going not to be interfered with the end portion of the rotary cam 1. The movement of 10 mm is achieved by the moving apparatus shown in Figs. 1, 4 and 5. In this case, $L = 10$ mm is established.

[0036] Figs. 12 to 14 show a state in which the rotary cam 1 is backward moved and rotated at 20° , and the rotary cam 2 is backward moved and rotated at 30° and moved at 10 mm. In this case, an end surface angle θ_2 of the rotary cam 1 is an obtuse angle, and the end surfaces in both elements are not interfered with each other.

[0037] In the embodiment mentioned above, as moving means for moving the rotary cam so as to be apart from another rotary cam, the moving rail and the roller for guiding the moving rail are provided, however, the present invention is not limited to this structure, and can employ a screw type movement, an air cylinder, a hydraulic pressure, a lever and the like.

[0038] The rotary cam 2 is moved so that a gap is formed between the rotary cam 2 and the rotary cam 1, however, the rotary cam 1 may be moved together with the rotary cam 2 in a direction of moving apart from each other. The rotary cam 1 may be moved at a time when the rotary cam 2 starts a little rotating. The rotary cam 1 may be set to start moving after the rotary cam 2 finishes rotation. As mentioned above, by moving the rotary cam 2 and the rotary cam 1 in the direction of moving apart from each other, it is not necessary to execute an escaping process for avoiding the interference between the end portions of the rotary cam 1 and the rotary cam 2, and it is possible to maintain the strength of the end portions of the rotary cam 1 and the rotary cam 2.

[0039] In the embodiment, the description is given of the case that two rotary cams are provided, however, the present invention is not limited to this, and can be applied to three or more rotary cams.

[0040] Further, the description is given of the embodiment in which the rotational axes 3 and 4 of the rotary cams 1 and 2 exist on the same plane, however, the present invention is not limited to this, and includes the case that the respective rotational axes are positioned on the different planes or inclined surface.

[0041] As mentioned above, in accordance with the present invention, since there is provided the rotary cam moving apparatus of the negative angle shaping mold comprising: a lower mold which mounts a metal thin plate work on a supporting portion; an upper mold which descends in a linear direction with respect to the lower mold and comes into contact with the work to shape the work; a rotary cam which forms an intrusion shaping portion intruded from a locus of the upper mold in an edge portion close to the supporting portion, and is rotatably provided in the lower mold; a slide cam which has an intrusion shaping portion, and is slidably provided so as to oppose to the rotary cam; and an automatic resetting device which rotates and moves backward the rotary cam to a backward moved state capable of taking out

the work from the lower mold after shaping, and is provided in the lower mold, in which the work mounted on the supporting portion of the lower mold is shaped by the intrusion shaping portion of the rotary cam and the intrusion shaping portion of the slide cam by sliding the slide cam, and the shaped work is taken out from the lower mold by rotating and moving backward the rotary cam by means of the automatic resetting device after shaping, and a plurality of rotary cams are continuously arranged in an oblique shape, wherein one rotary cam of the adjacent rotary cams is moved so as to be apart from another rotary cam at a time of being rotated to a backward moved state, it is possible to avoid the interference of the rotary cams, require no canceling process in the rotary cam end portions with a high accuracy, and maintain the strength in the rotary cam end portion.

[0042] Further, in accordance with the present invention, in particular, the moving rail and the roller for guiding the moving rail are provided as moving means for being apart from another rotary cam.

Claims

1. A negative angle shaping mold comprising:

a lower mold with a supporting portion on which a metal thin plate work can be mounted;
an upper mold which is adapted to descend in a linear direction with respect to said lower mold and to come into contact with the work;
a rotary cam comprising a plurality of rotary cam sections rotatably provided in the lower mold and being provided with an intrusion shaping portion intruded from a locus of the upper mold in an edge portion close to the supporting portion;
a slide cam slidably provided so as to oppose to said rotary cam and having an intrusion shaping portion for shaping the work in cooperation with the intrusion shaping portion of the rotary cam;
an automatic resetting device provided in the lower mold for rotating and moving backward the rotary cam to a backward moved state where the work can be taken out from the lower mold after shaping; and
a rotary cam moving means for moving at least one of said rotary cam sections apart from an adjacent one of said rotary cam sections when the rotary cam is rotated to a backward moved state.

2. The negative angle shaping mold according to claim 1, wherein said plurality of rotary cam sections of said rotary cam are continuously arranged in an oblique shape.

3. The negative angle shaping mold according to claim 1 or 2, wherein said rotary cam moving means is adapted to move said at least one rotary cam section apart from said adjacent rotary cam section in an axial direction of the rotation axis of said at least one rotary cam section. 5
4. The negative angle shaping mold according to claim 1, 2 or 3, wherein said rotary cam moving means comprises a moving rail having a predefined contour for effecting said movement of said at least one rotary cam section apart from said adjacent rotary cam section and at least one roller for guiding the moving rail. 10 15
5. The negative angle shaping mold according to claim 4, wherein said moving rail is fixed to said at least one rotary cam section and said at least one roller is rotatably provided in the lower mold. 20

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FIG. 1

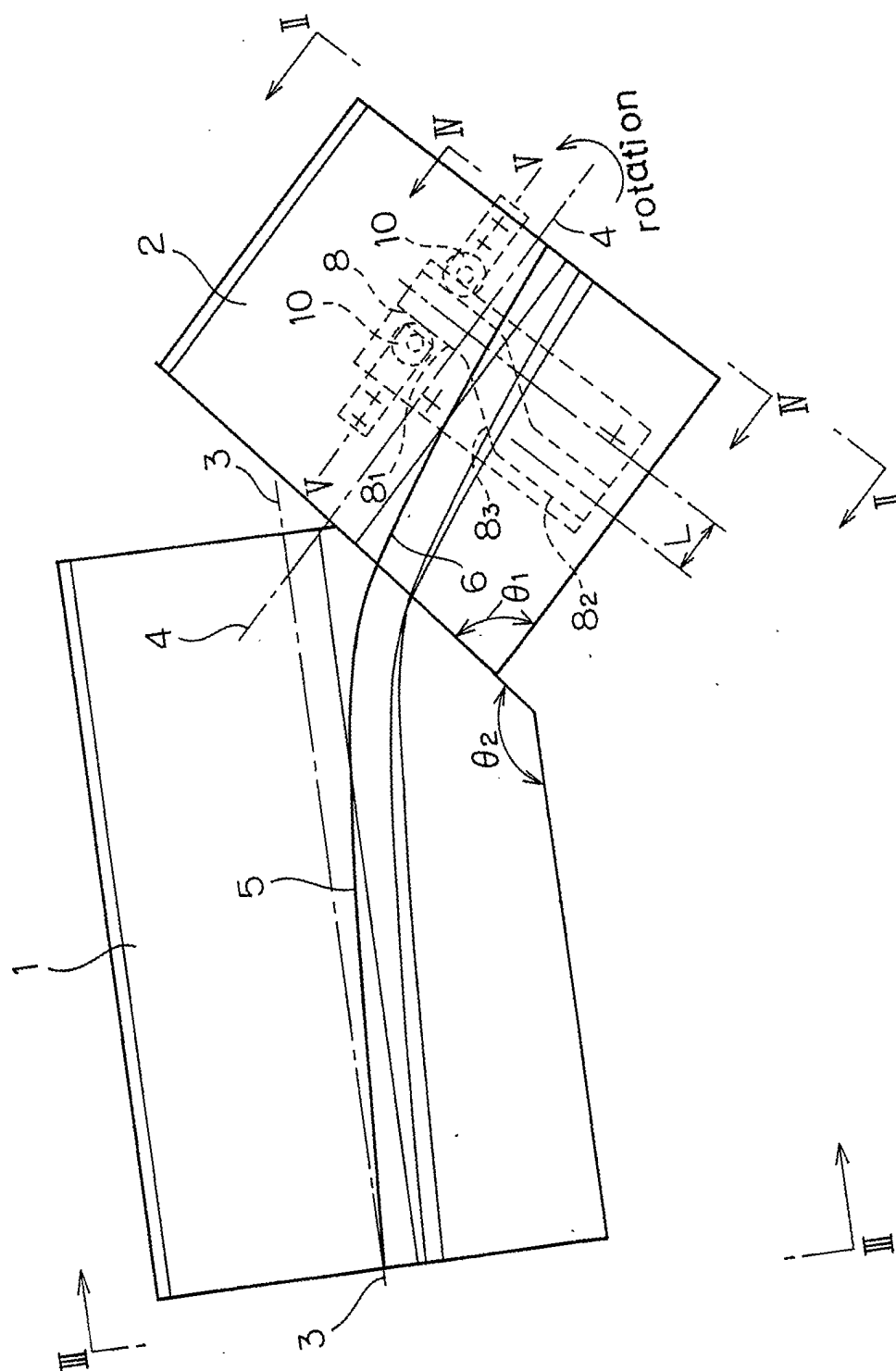


FIG. 2

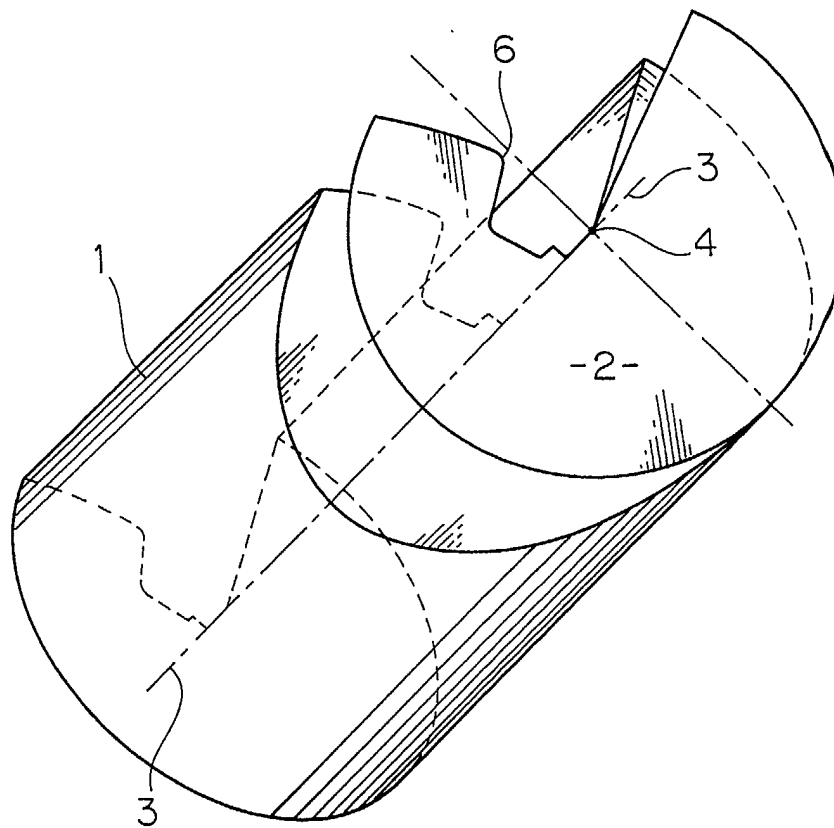


FIG. 3

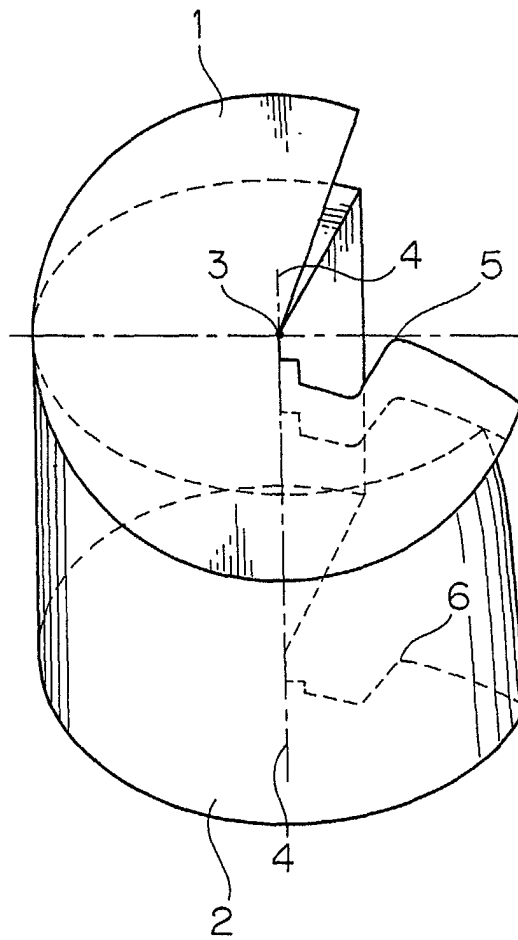


FIG. 4

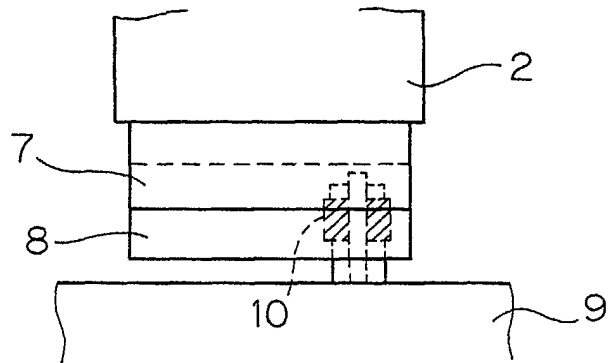


FIG. 5

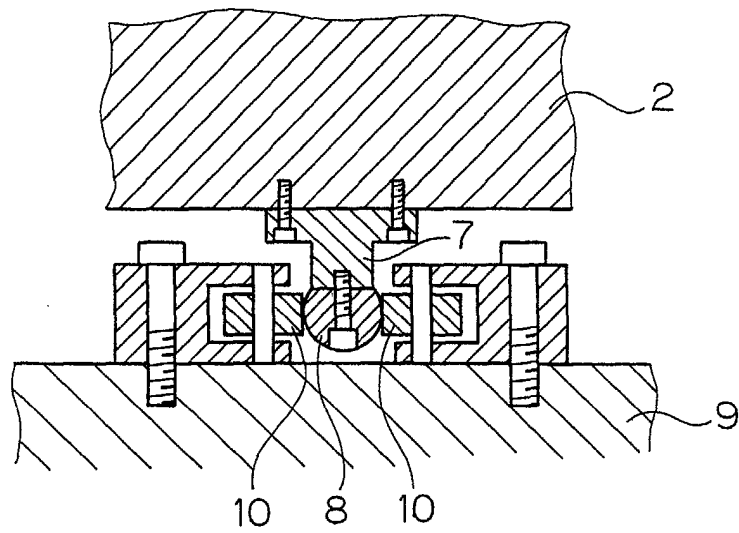


FIG. 6

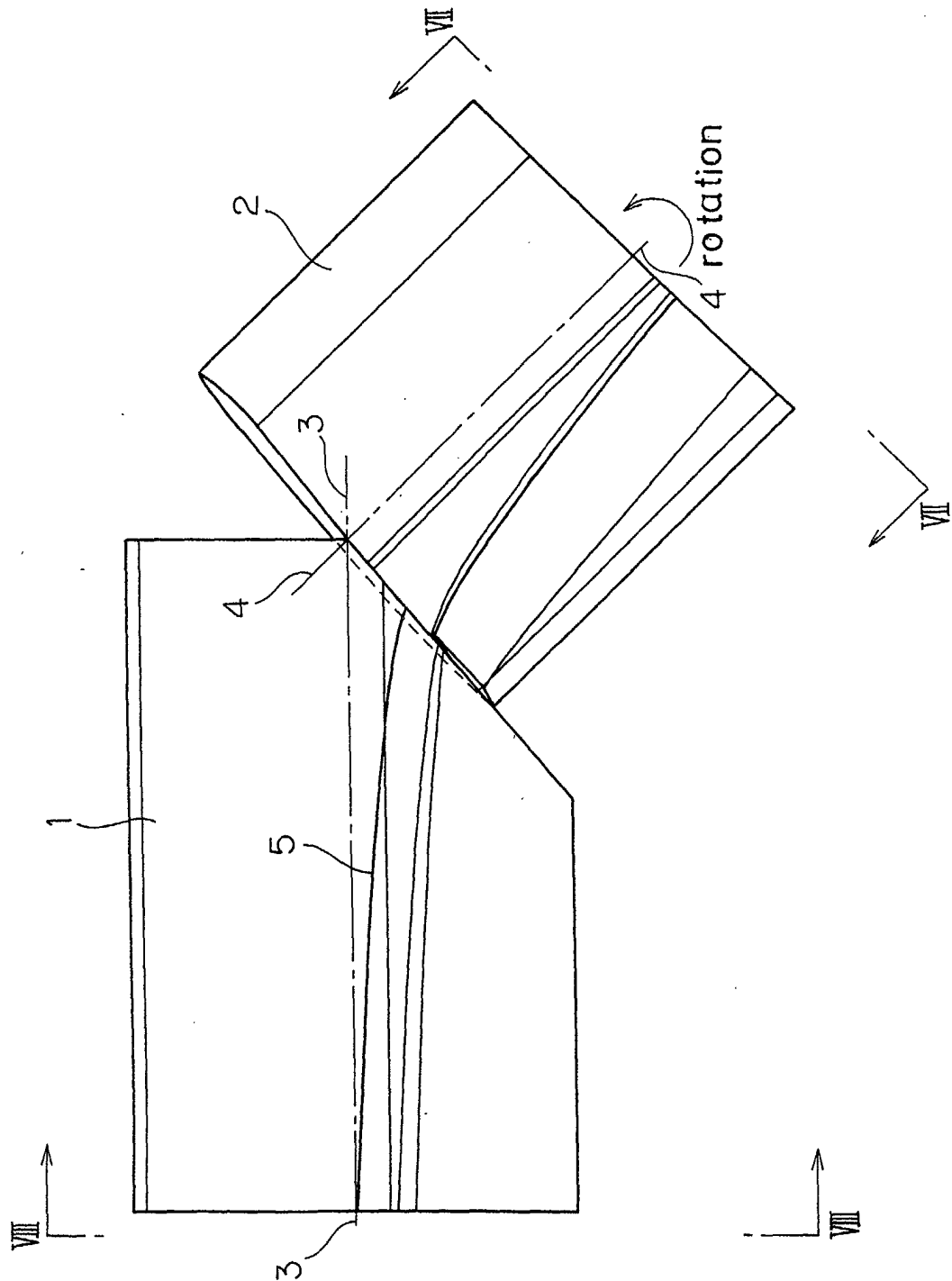


FIG. 7

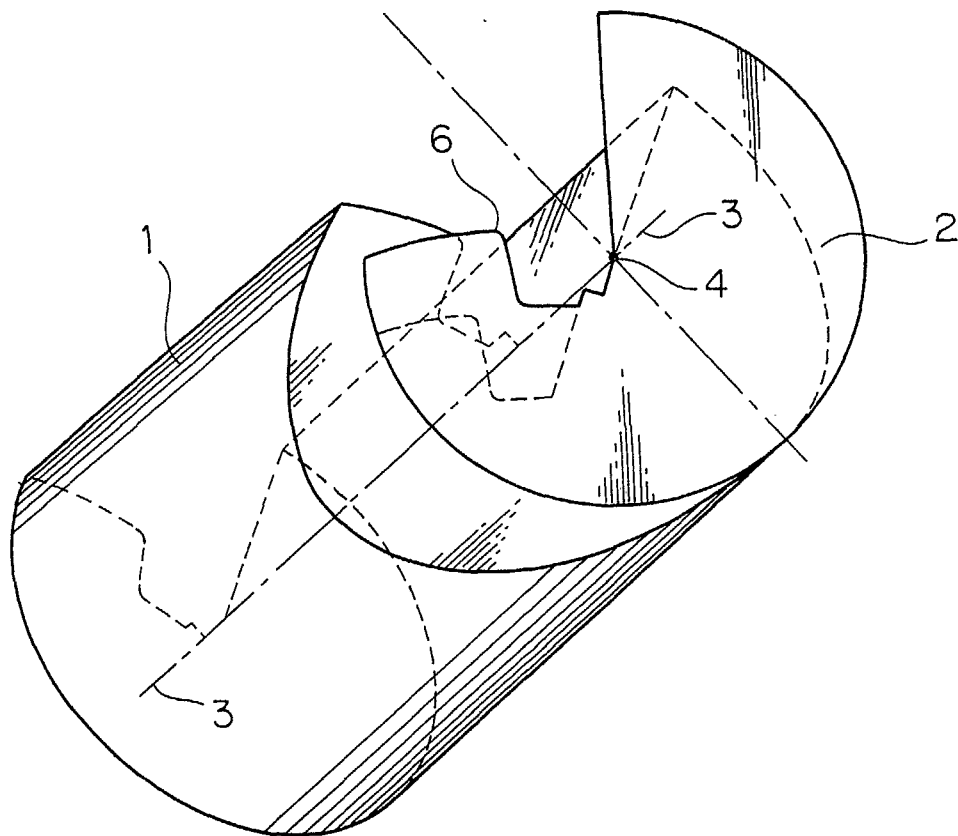


FIG. 8

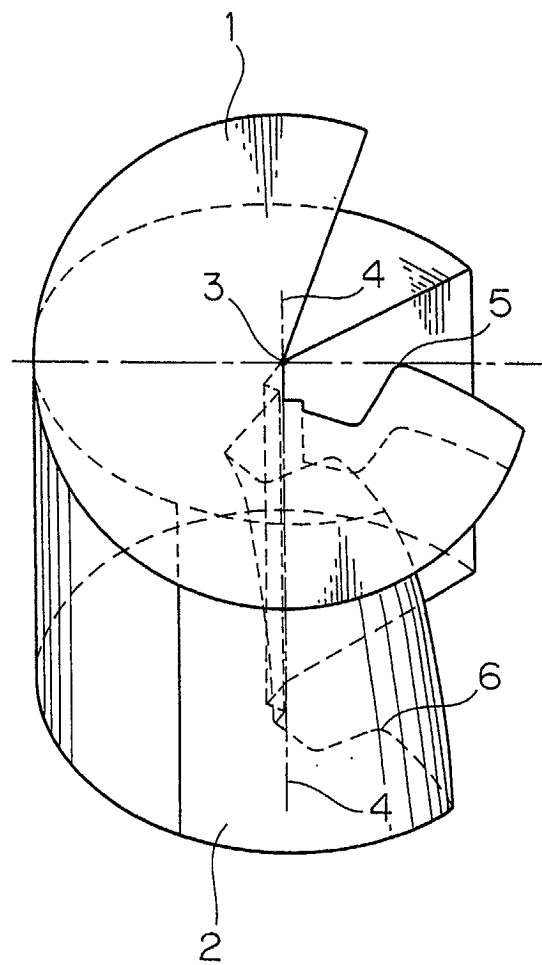


FIG. 9

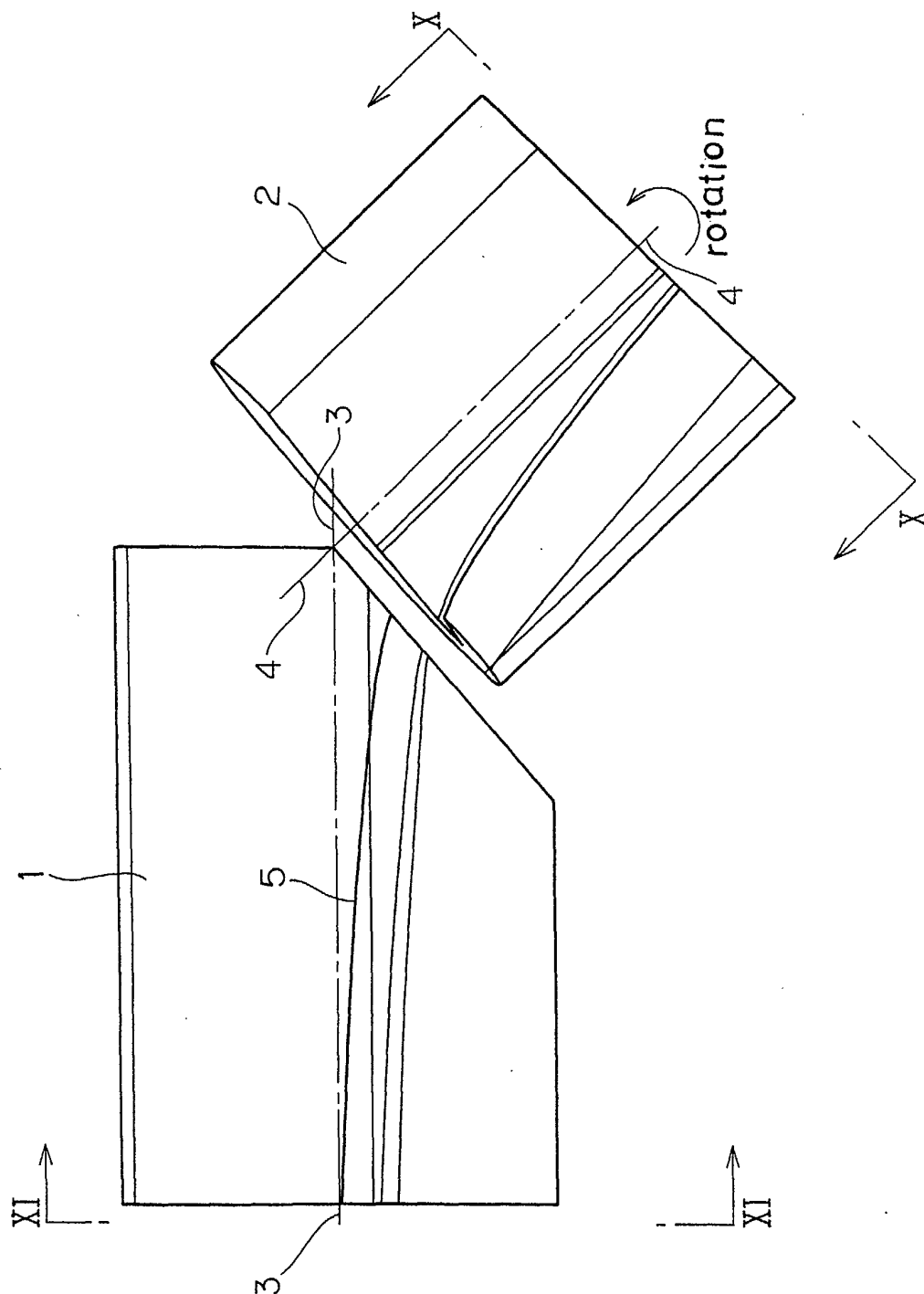


FIG. 10

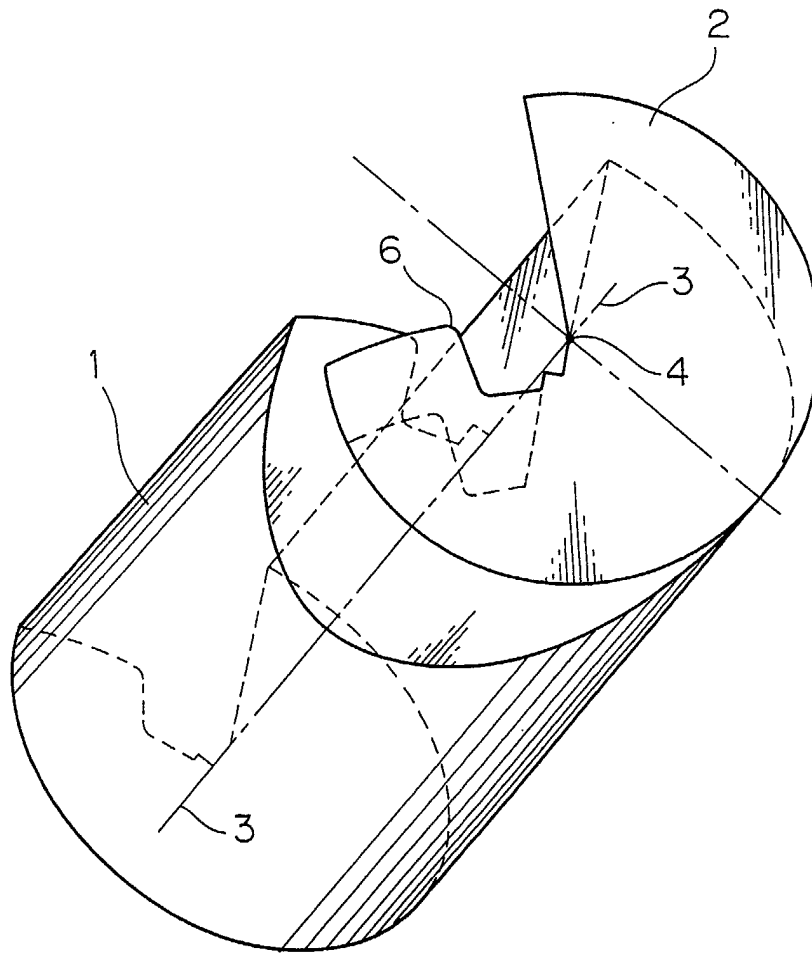


FIG. 11

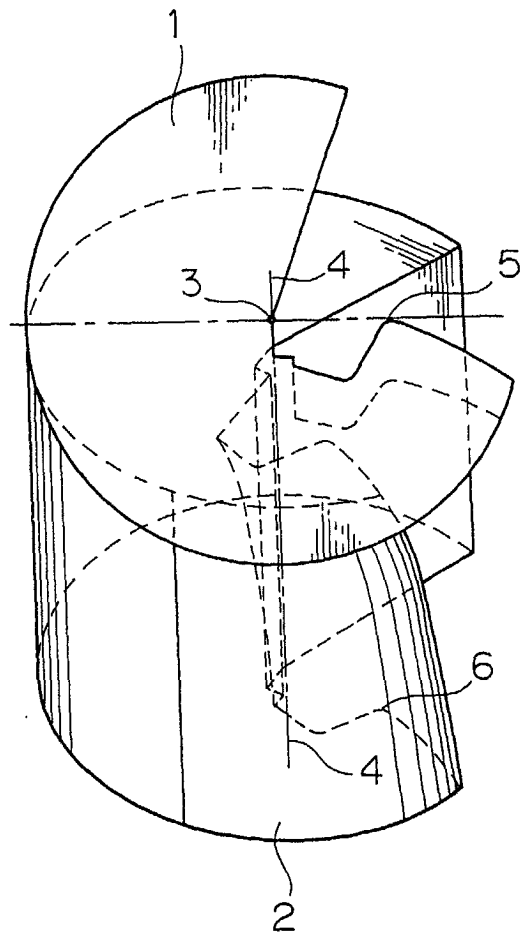


FIG. 12

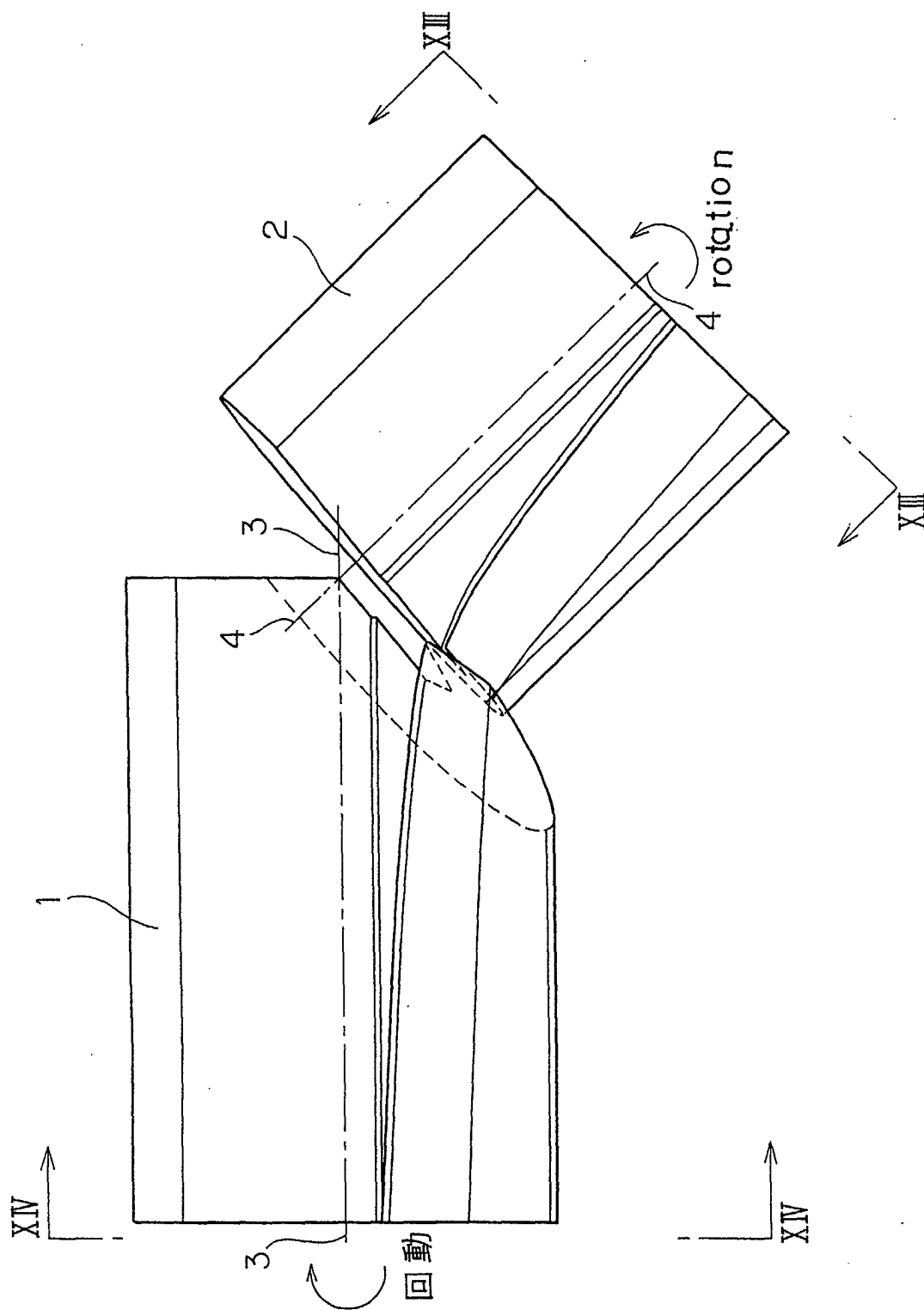


FIG. 13

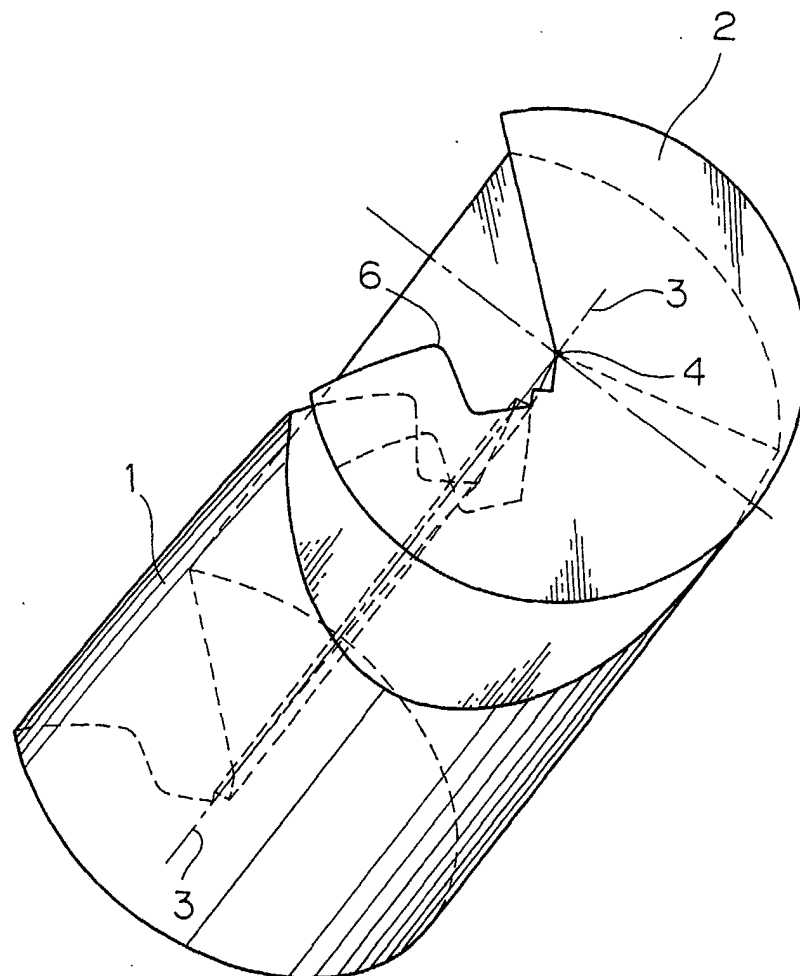


FIG. 14

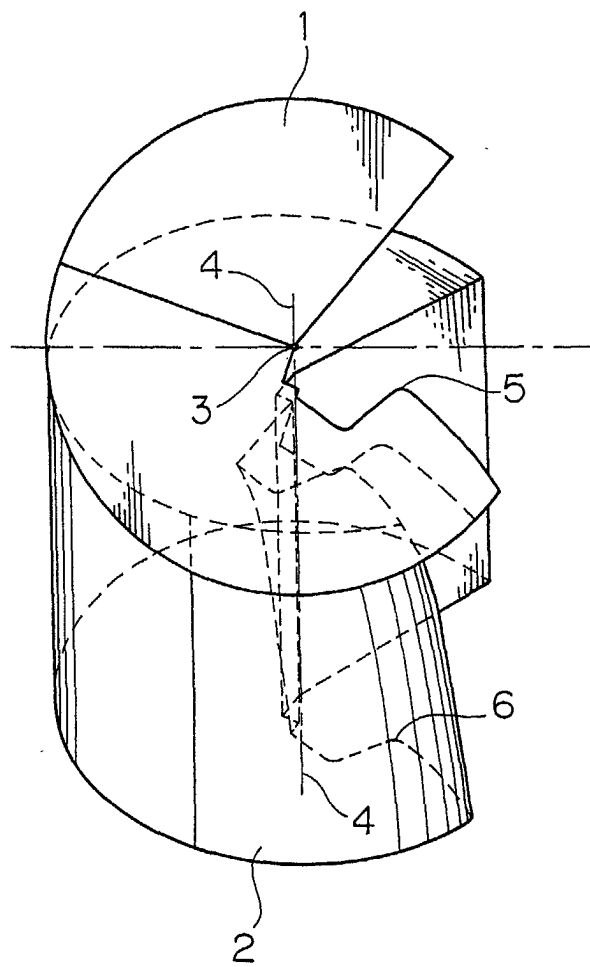


FIG. 15

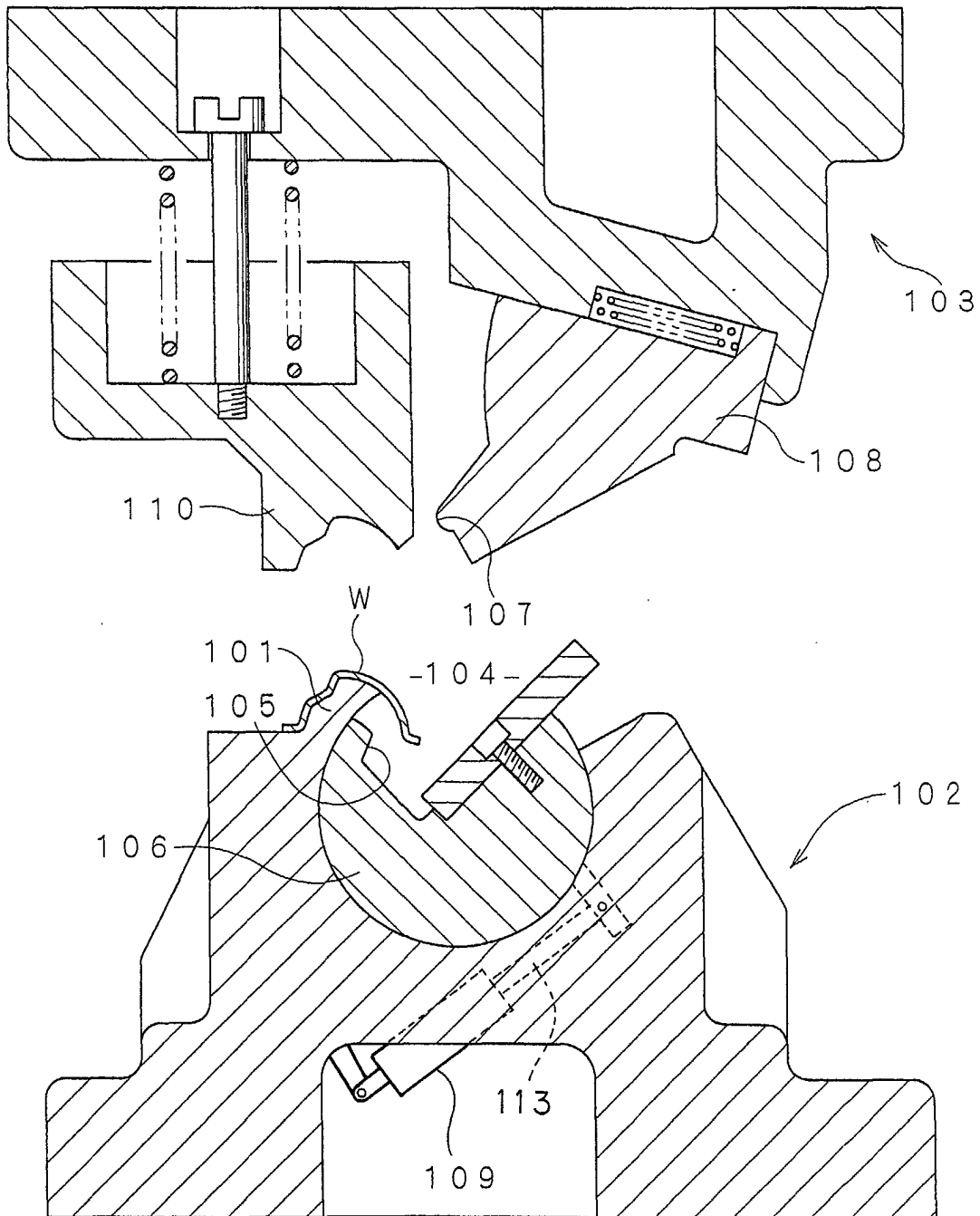


FIG. 17

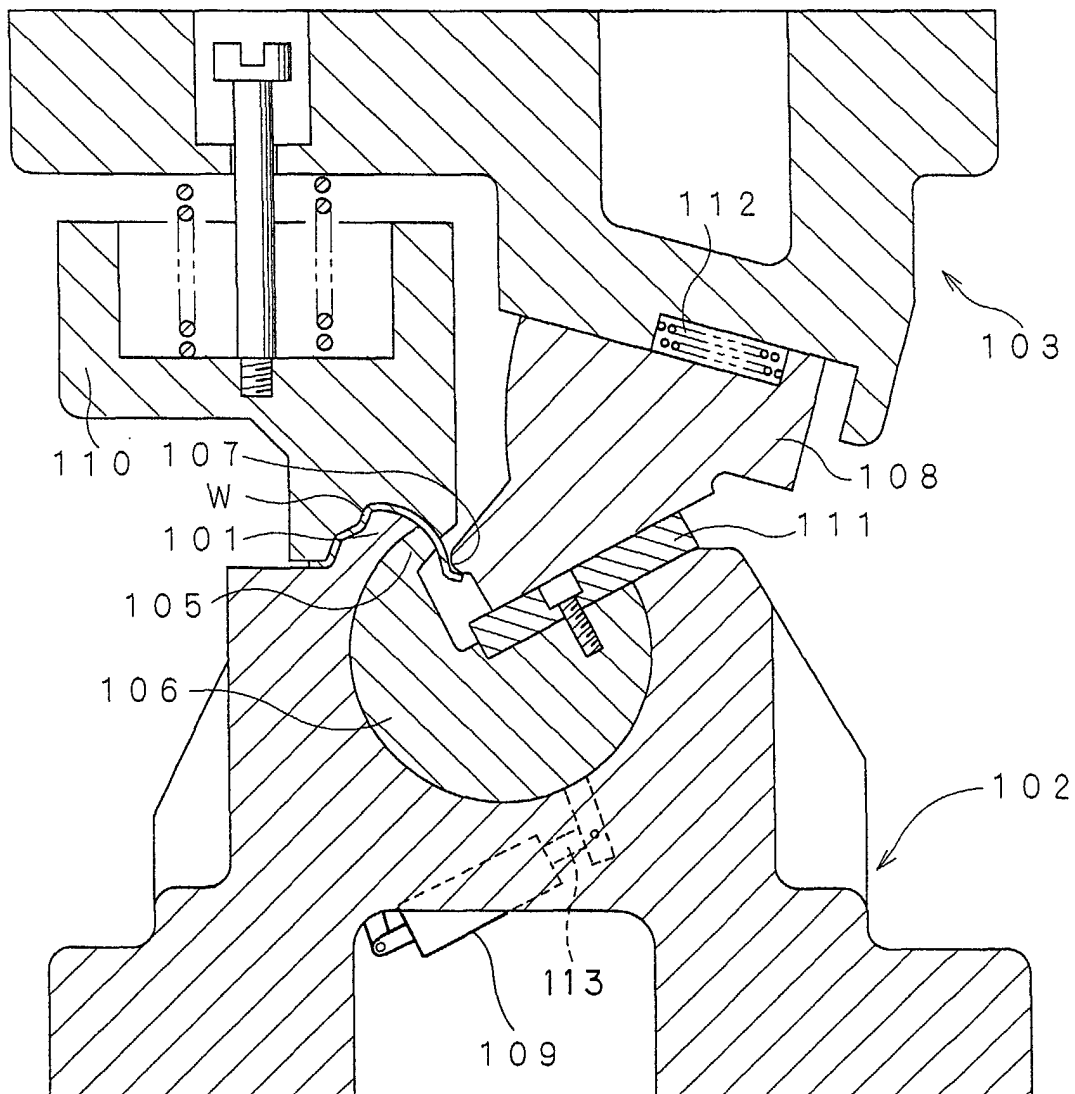


FIG. 18

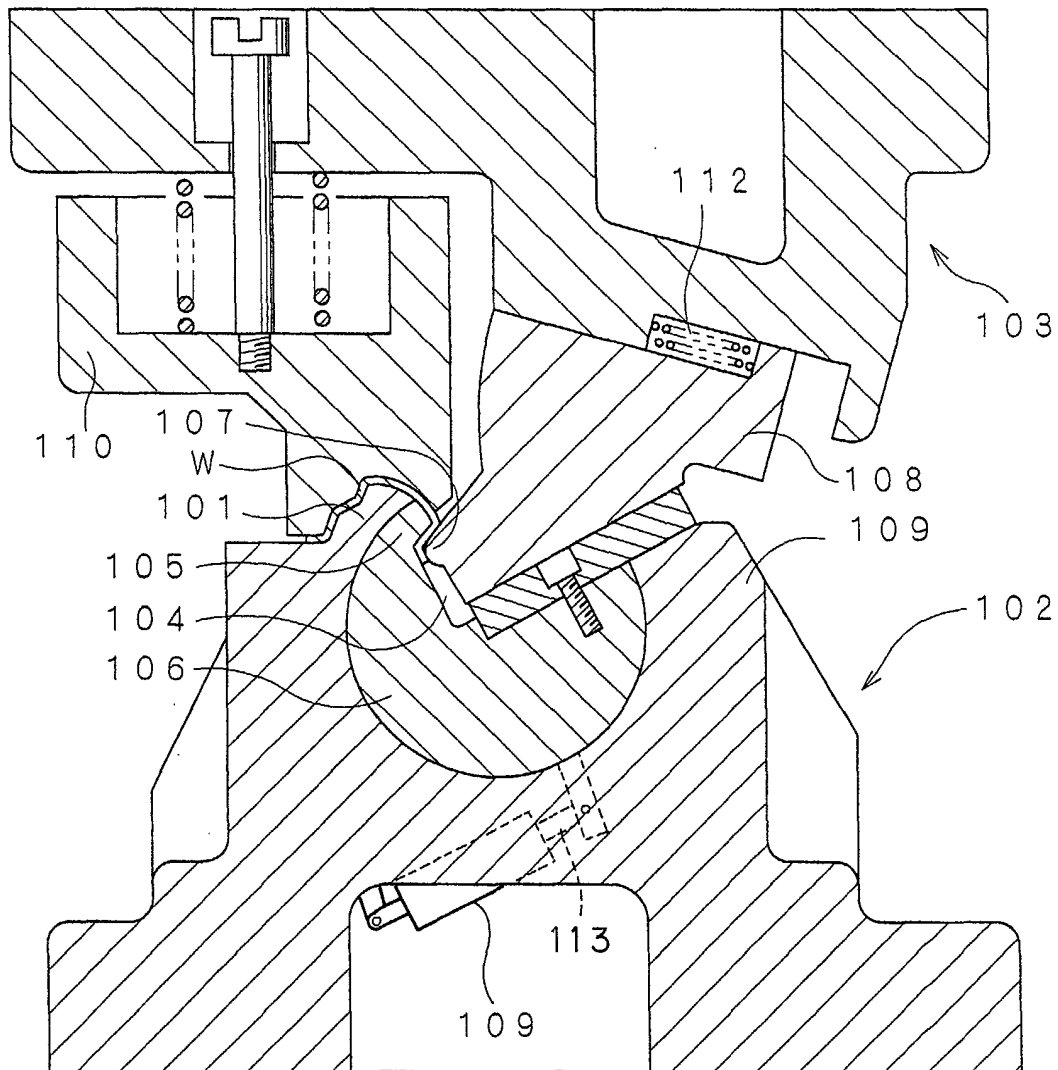


FIG. 19

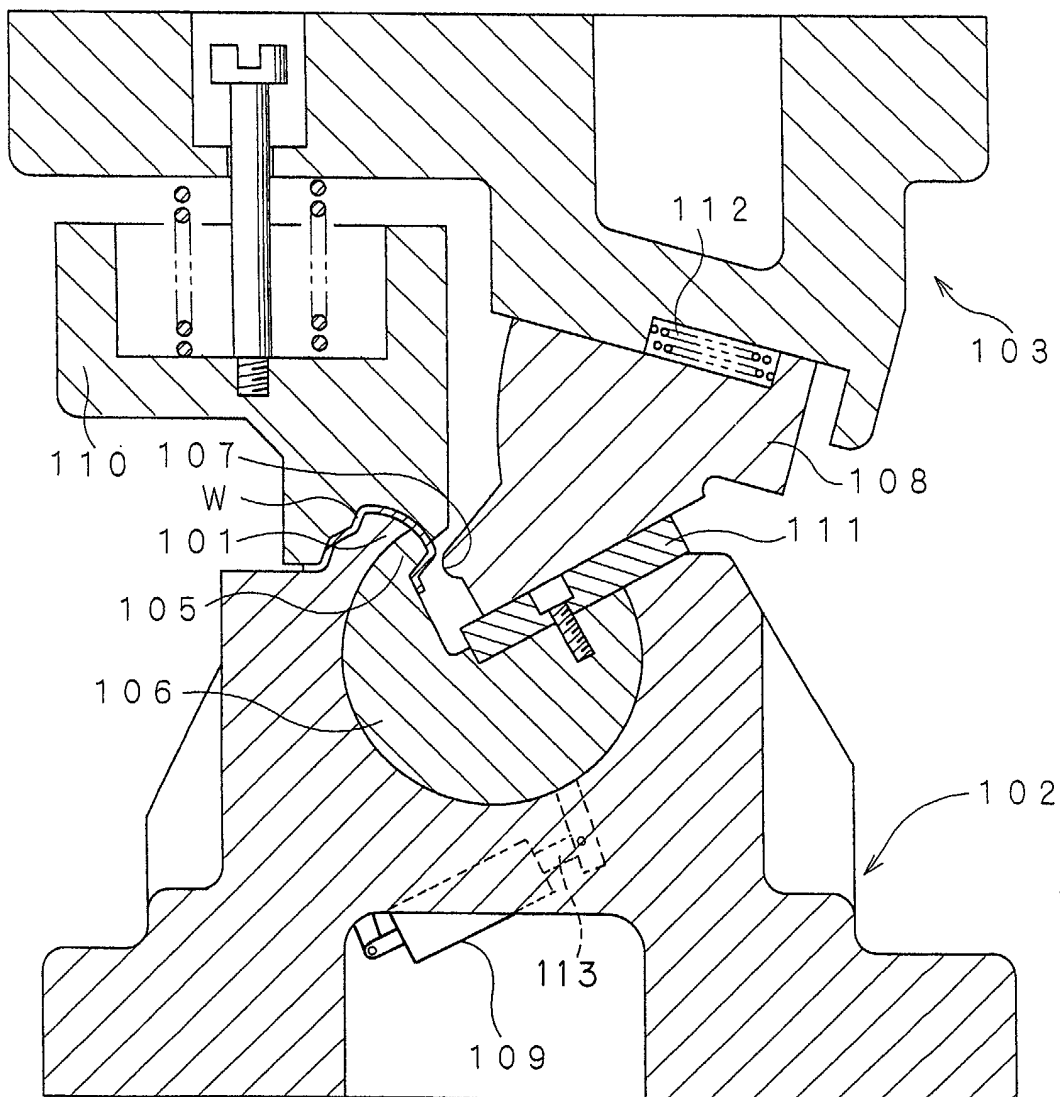
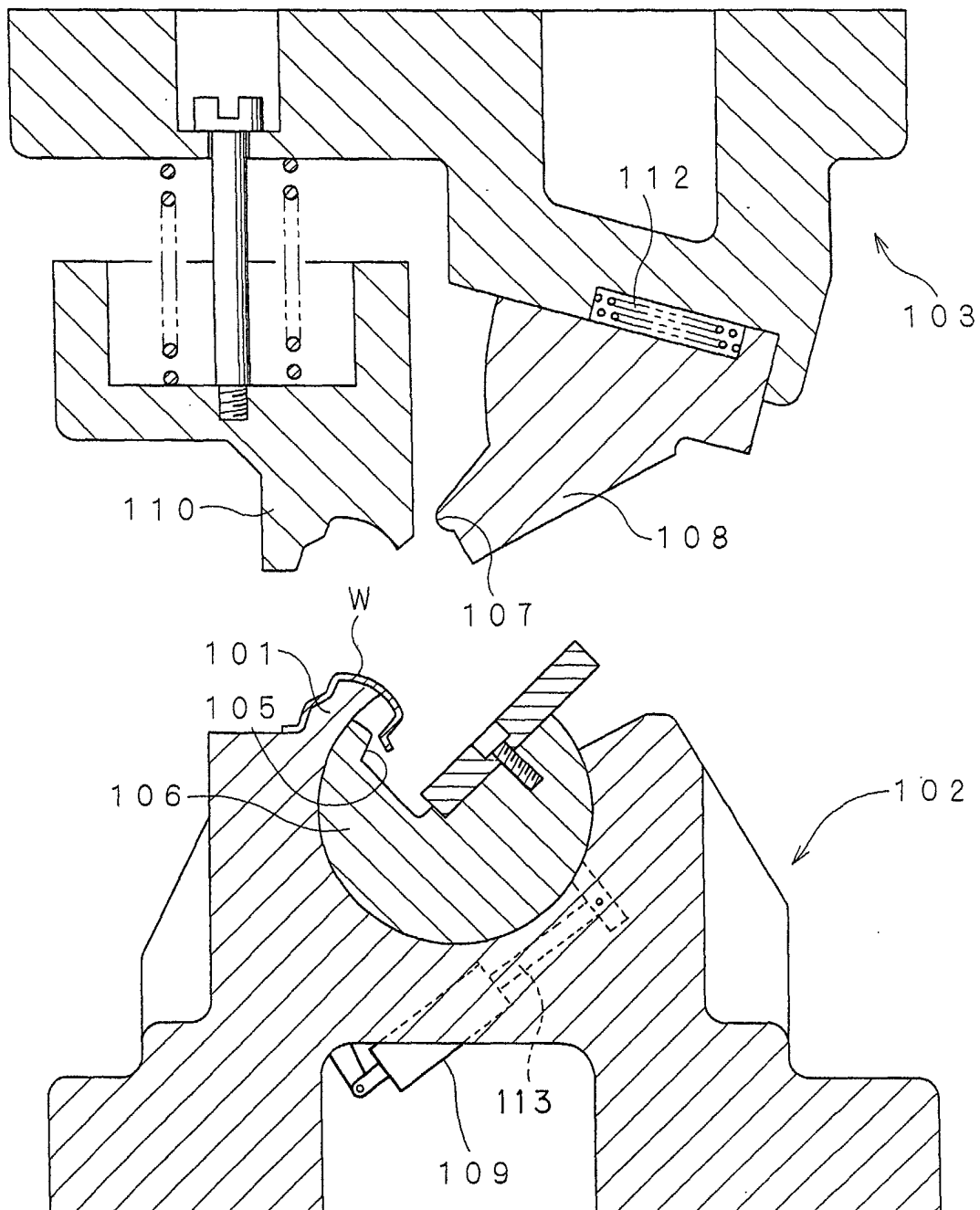


FIG. 20





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 7699

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 11, 30 September 1998 (1998-09-30) -& JP 10 166061 A (TOYOTA AUTO BODY CO LTD), 23 June 1998 (1998-06-23) * abstract; figures *	1,3	B21D5/04 B21D22/08
A	---	2,4,5	
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 10, 30 November 1995 (1995-11-30) -& JP 07 185664 A (TOYOTA MOTOR CORP), 25 July 1995 (1995-07-25) * abstract; figures *	1,3	
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A	EP 0 699 489 A (UMIX CO LTD) 6 March 1996 (1996-03-06) * abstract; figures *	1,2	
A	---	1	
A	EP 0 857 525 A (UMIX CO LTD) 12 August 1998 (1998-08-12) * claims 1,2; figures *		TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 06, 30 April 1998 (1998-04-30) -& JP 10 052719 A (TOYOTA MOTOR CORP), 24 February 1998 (1998-02-24) * abstract; figures *	1	B21D
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 11 March 2003	Examiner Meritano, L
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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